

## BUILDING THE CAPACITY OF SMALL SCALE COCOA FARMERS TO CONDUCT ON-FARM FERMENTATION

Joseph Mulindwa, Kaaya, A.N., Daphne B. N., Muganga L. & Chemutai J.

National Coffee Research Organization (NaCORI); Makerere University, School of Food Technology, Nutrition & Bio-engineering

### EXECUTIVE SUMMARY

Cocoa is Uganda's fourth highest foreign revenue earner. However, postharvest handling of the crop is labour intensive, leads to loss of revenue, and is not gender inclusive.

This new study looks at strategies to address these challenges by designing a single fermentation box. If the technology is adopted it will not only improve the quality of the fermented beans with reduced fermentation period, but will also be gender inclusive.

#### KEY ISSUES

- Sale of unfermented beans by farmers
- Lack of cocoa specific extension services
- Lack of a regulator for the cocoa subsector
- Low funding to cocoa research in Uganda

### OVERVIEW

Cocoa is one of the ten strategic crops in Uganda<sup>1</sup>, currently ranking fourth in foreign revenue contributions. Production in Uganda has increased over the past five years from 26,352 tonnes in 2013 to 30,752 tonnes in 2018<sup>2</sup>.

The provision of cocoa seedlings by the Operation Wealth Creation (OWC) to farmers is expected to increase production. Most production occurs in Bundibugyo, Mukono, Buikwe, Hoima, Kibale and Mpigi. Small-scale farmers with an average acreage of less than a hectare are the ones who grow cocoa.

Cocoa goes through a series of postharvest handling procedures including pod breaking, fermentation, drying and bagging. Fermentation and drying affects the quality of beans and the resultant secondary products (chocolate and cocoa butter). Fermentation is a costly stage that requires training and resources that are not easily accessible to smallholder farmers in Uganda; thus forcing farmers to sell fresh cocoa beans instead of dry beans. Previous research highlights lack of knowledge on postharvest handling as one of the challenges faced by cocoa growers in Uganda<sup>3</sup>.

This brief therefore highlights the currently used cocoa fermentation methods and their associated challenges. It also provides policy recommendations.

### INTRODUCTION

Cocoa directly supports over 15,000 households in Uganda and production has increased over the past five years with volumes reaching 29,761 tonnes.

Fermentation is one of the vital steps that ensure the development of chocolate flavour precursors determining the quality of resultant chocolate and price offered to farmers. Fermentation and drying are dependent on the climate and weather conditions that affect the quality and eventual pricing of cocoa. During fermentation, the mucilaginous sugary pulp that surrounds the bean is liquefied. Fermentation reduces bitterness and astringency in cocoa beans, leading to the formation of flavour precursors (Meersman et al., 2016).

The world cocoa organisation recommends two forms of fermentation: wooden boxes and heaps<sup>4</sup>. In Uganda, several fermentation methods are used depending on the location.

<sup>1</sup>Agriculture Sector Strategic plan 2015/16 to 2019/20

<sup>2</sup>Uganda Bureau of Statistics: Statistical Abstracts 2019

<sup>3</sup>Lutheran World Relief (U), (2015). Players and stakeholders in the cocoa value chain of Bundibugyo. Mountains of the Moon University Occasional Papers No. 6

<sup>4</sup><https://www.icco.org/>



**Figure 1:** Recommended methods of cocoa fermentation (box and heap)

## COCOA FERMENTATION METHODS CURRENTLY EMPLOYED IN UGANDA

### Tower box fermentation

Plantation farmers and buyers of fresh cocoa who do bulk fermentation at their premises use this method. To achieve uniform fermentation and bean quality, the boxes have a volume from 800kg to 2,000kg.

The boxes have holes to allow the liquefied pulp to drain out. They are covered with banana leaves or jute bags to conserve the heat generated during fermentation and then tied to allow easy transfer of beans from one box to another. The transfer of beans takes place after 48 hours of fermentation which takes up to 144-168 hours.

The method is labour intensive and requires larger volumes to achieve the desired quality. This leaves small-scale farmers with no option but to sell their

cocoa fresh at a low price. In addition, the tower fermentation boxes also limit women from engaging in the process due to energy requirements.

### Heap fermentation

Smallholder farmers mainly practice this method and the heaps can range from 50 to 2,000kgs. Banana leaves are laid on a levelled ground, beans are heaped and covered with banana leaves again to provide for insulation.

The beans are turned either on the second or third day and fermentation usually lasts for six to seven days. The turning of beans allows aeration and ensures uniform fermentation. The major challenge with this method is theft of cocoa beans as the fermentation is carried out in the field.

### Other methods

Some of the methods mostly practiced by farmers include; fermentation in underground holes, baskets,

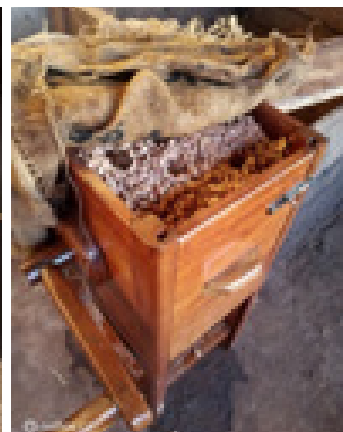
jerry cans, sacks, and basins. These methods of fermentation do not have a provision for liquefied pulp to drain and lead to partial fermentation and rotting of beans.

## APPROACH AND RESULTS

### Single box fermentation

National Coffee Research Institute (NaCRI) and Makerere University developed the single box fermenter. The aim is to aid fermentation at farm level because majority of the farmers have less than a hectare thus producing approximately 70kg of cocoa bean pulp in two weeks.

The box is designed with a hand crank, which aids in the turning of the fermenting cocoa after 48 hours. For efficient mixing, the crank has rakes that are in contact with fermenting content thus facilitating uniform mixing.



**Figure 2:** Fermentation methods practiced by farmers that are not recommended

**Figure 3:** Single fermentation box showing the inside design and loaded box



**Figure 4:** Cocoa bean colour after four days of fermentation

The box can handle 60 to 100kg of cocoa and has shown the potential to reduce the fermentation time from six to four days with 99% fermented beans. Unlike the tower fermentation boxes and heaps that require manual mixing using a rod/stick, the single box uses a crank that operates on the principle of an engine. This reduces the energy required to operate it. This method also reduces theft because fermentation can occur in an enclosed place. The localised fermentation also facilitates easy collection of sweating that is produced during fermentation. The sweating is highly acidic and if disposal is not controlled has the potential to deteriorate the environment.

This technology if adopted will:

- Reduce the cost of fermentation
- Increase the quality of processed cocoa at farm-level
- Increase gender-inclusiveness
- Increase the overall market value of Uganda's cocoa

**Assessment of fermented bean quality**

Parallel fermentation trials were done using the single box and tower fermentation boxes. During fermentation, samples were picked on the fourth day and bean cut taste performed. The bean cut taste requires cutting the cocoa bean longitudinally after which the colour is assessed.

The flesh of a well-fermented cocoa bean is wood brown while non-fermented is purple. On the fourth day, 99% of the cocoa under the single fermentation box had fermented while beans in the tower boxes were still under fermented. The single fermentation box also has the potential to rapidly build temperature and retain it, this facilitates the fast fermentation process.

**CONCLUSIONS**

- For small-scale farmers to productively benefit from the cocoa enterprise, there is need to add value to the beans through fermentation.
- Creation of producer societies by farmers is one way that can be employed to facilitate bulk fermentation. Farmers in organised societies easily receive extension services and have a high bargaining power.
- Government intervention in the cocoa value is expected to improve the livelihoods of farmers thus helping in the realisation of the middle-income status by 2040.

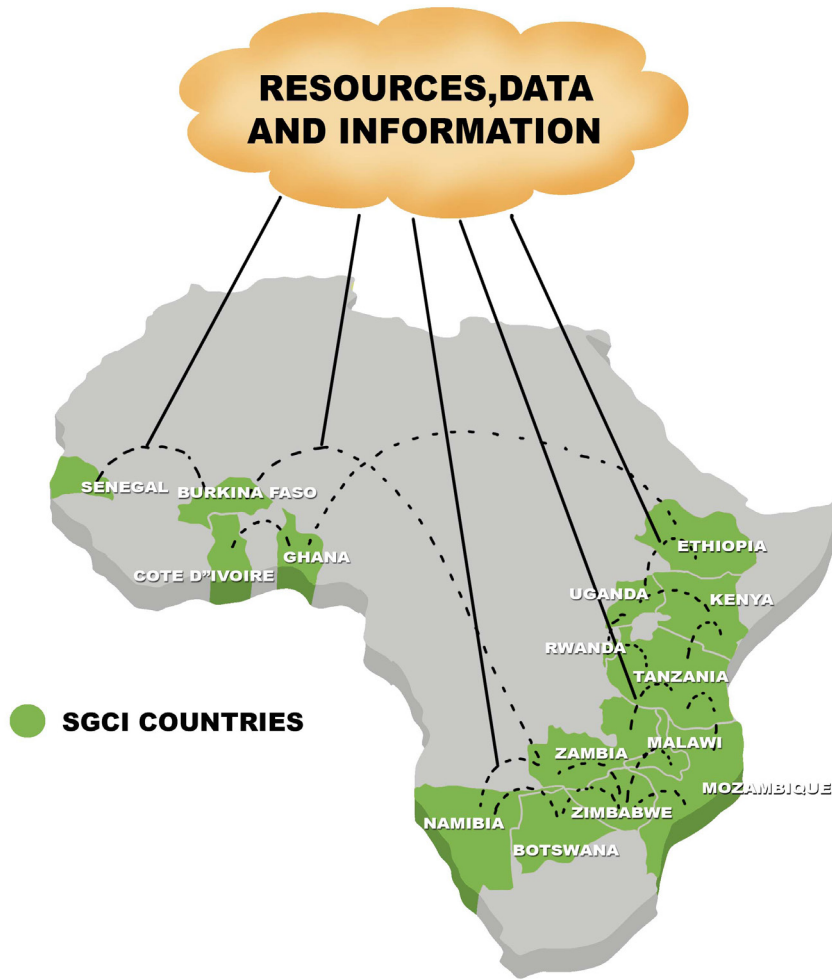
**RECOMMENDATIONS**

- The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) should provide cocoa specific extension services to sensitise farmers about the need for well-fermented beans.

- The MAAIF and Ministry of Trade, Industry and Cooperatives (MTIC) should sensitise small-scale farmers to form producer societies to carry out bulk fermentation.
- The MAAIF should support cocoa research to multiply the innovative fermentation methods that can handle small volumes.
- Cocoa buyers should incentivise farmers that bring well-fermented beans.
- The local governments in producing areas should set by-laws to ensure cocoa quality.
- There is need to create a cocoa regulatory authority.



Tanzania



The Scinnovent Centre  
 Second Floor, Karen Plains Arcade  
 P.O. Box 52486 - 00100, GPO, Nairobi, Kenya  
 Website: [www.scinnovent.org](http://www.scinnovent.org); Tel: +254 020 2173433